SUTURE LOCKING AND CUTTING DEVICES AND METHODS

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Abstract

Suture holding devices and methods are disclosed, including devices and methods useful in performing a transoral surgical procedure, such as a posterior gastropexy procedure. A device is disclosed which can be used by a physician in a medical procedure to automatically lock and cut a suture in one motion and without the need for additional cutting instrumentation, rather than perform separate locking and cutting actions.
Suture lock assembly 100

Distal endcap 114

Proximal endcap 116

Extension spring 112

Hole 120

Suture 118

FIG. 1A

Suture lock assembly 100

Distal endcap 114

Suture 118

Hollow channel 121

Extension spring 112

Proximal endcap 116

Hole 120

FIG. 1B
FIG. 2
Method 700

710 Passing EUS endoscope into stomach
712 Locating fixation point outside of stomach
714 Pushing tag and suture through stomach wall
716 Deploying and affixing tag to fixation point
718 Withdrawing EUS endoscope from patient

720 Threading suture through endoscope working channel
722 Passing standard endoscope into stomach
724 Loading suture lock assembly into suture lock actuating device
726 Threading suture through suture lock assembly

728 Feeding suture lock assembly and suture lock actuating device through endoscope working channel
730 Activating the locking mechanism
732 Activating the cutting mechanism
734 Withdrawing instrumentation and surplus suture from patient

End

FIG. 7
Suture lock assembly 800

First tissue 122
First groove 824
Lock body 810
Second groove 825
First locking ring 820
Lock sleeve 816
Second locking ring 822

T-tag 126
Second tissue 124
Suture channels 812
Locking holes 814
Suture 118

FIG. 8
FIG. 9
FIG. 10
SUTURE LOCKING AND CUTTING DEVICES AND METHODS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to and incorporates by reference the following applications: U.S. Provisional Application 60/571,117 filed May 14, 2004; U.S. provisional Application 60/571,119 filed May 14, 2004; and U.S. Provisional Application 60/571,000 filed May 14, 2004.

FIELD OF THE INVENTION

[0002] This invention relates to endoscopic suturing devices and methods, including devices and methods which may pass through or be employed in connection with the working channel of various endoscopic and ultrasound devices.

BACKGROUND

[0003] Application of sutures in the gastrointestinal tract is required for several different types of medical procedures, for example, for transoral endoscopic valvuloplasty for gastroesophageal reflux disease (GERD), gastroplasty, funndoplication, anterior gastroplasty, posterior gastroplasty, suture of esophageal perforations, or closure of the esophageal side of the tracheo-esophageal fistula. Traditionally, these procedures are performed by physicians, such as gastroenterologists or surgeons, either by laparoscopy or open surgical techniques. Such procedures are invasive, as laparoscopy requires that small access incision(s) be made in the body of the patient, through which a laparoscope and other surgical enabling tools are provided, while open surgical techniques are traditionally invasive and can have complications and cause long patient recovery periods.

[0004] The solution to these problems is to perform these medical procedures through the gastrointestinal tract via the mouth or other naturally occurring orifice. Already available flexible endoscopes, commonly called gastrosopes, can be provided through the gastrointestinal tract and enable illumination and visualization of tissue along the gastrointestinal tract on a video display for diagnostic purposes. These flexible endoscopes also provide an instrumentation means for applying sutures in tissue, such as in the wall of the stomach. What is needed are improved methods of providing a totally transoral surgical procedure, such as a posterior gastroplasty procedure, and thereby avoid more invasive laparoscopic procedures.

[0005] New endoscopic suturing methods performed through the gastrointestinal tract as an alternative to the invasive laparoscopic method of, for example, a posterior gastroplasty procedure, are currently being developed. For example, suturing methods under the control of endoscopic ultrasound (EUS) are being evaluated. EUS is a procedure that combines endoscopy and ultrasound. In particular, a Mar. 14, 2003 publication authored by Fritsch-Ravens, Mosse, Mukherjee, Yatuki, Park, Mills, and Swain, entitled, “Transgastric gastroplasty and hiatal hernia repair for GERD under EUS control: a porcine model,” (American Society for Gastrointestinal Endoscopy) describes how endoluminal operations for gastroesophageal reflux are currently limited by the inability of the surgeon to visualize and manipulate structures outside the wall of the gut. The publication describes a way to define the EUS anatomy of structures outside the gut that influence reflux, to place stitches in the median arcuate ligament, to perform posterior gastroplasty, and to test the feasibility of crural repair, under EUS control, in pigs. More specifically, by using a linear-array EUS, the median arcuate ligament and part of the right crus were identified and punctured with a needle, which served as a carrier for a tag and suture. These were anchored into the muscle. An endoscopic sewing device was used, which allowed stitches to be placed through a 2.8-mm accessory channel to any predetermined depth.

[0006] The publication also describes new methods of knot tying and suture cutting through the 2.8-mm channel of the EUS. More specifically, stitches were placed through the gastric wall into the median arcuate ligament, and one stitch was placed just beyond the wall of the lower esophageal sphincter. The stitches were tied together and locked against the gastric wall, and the surplus length of suture material was then cut and removed. While this publication describes a suitable transgastric gastroplasty and hiatal hernia repair procedure, further improvements in methodology and equipment to perform such procedures would be beneficial. For example, the publication describes a process for locking and cutting the suture from inside the stomach. However, the suture requires that a separate suture cutting step, along with its associated cutting instrumentation, be available via the working channel of the endoscope. This may result in multiple passes of instrumentation back and forth through the working channel of the endoscope. What is needed is a way to both lock and cut a suture automatically with a single device and thereby simplify the medical procedure, such as a posterior gastroplasty procedure.

[0007] Additionally, the locking mechanism described in the publication is too large to pass through the working channel of an endoscope and, thus, must be inserted into the patient separately from the endoscope, which again adds complexity to the medical procedure. What is needed are suture locking and cutting mechanisms that are small enough to pass through the working channel of various endoscopic and ultrasound devices (typical working channel diameter is 2.8-3.4 mm).

SUMMARY OF THE INVENTION

[0008] Applicants recognize the desirability of providing improved methods of performing a totally transoral surgical procedure, such as a posterior gastroplasty procedure, and thereby avoid more-invasive laparoscopic procedures. Applicants also recognize the desirability of providing a single mechanism for automatically locking and cutting a suture and thereby simplifying medical procedures, such as, but not limited to, a posterior gastroplasty procedure; and the desirability of providing suture locking and cutting mechanisms that are small enough to pass through the working channel of various endoscopic and ultrasound devices.

[0009] Certain embodiments of the present invention are directed to providing improved methods of performing a totally transoral surgical procedure, such as a posterior gastroplasty procedure, and thereby avoiding more-invasive laparoscopic procedures. One embodiment of the present invention provides a device and method that allows a physician in a medical procedure to automatically lock and cut a suture in one motion and without the need for additional cutting instrumentation, rather than perform separate locking and cutting actions.
In one embodiment of the invention, a suture lock assembly in combination with a lock actuating device is provided. The lock comprises an extension spring arranged between two endcaps, wherein one or more sutures are locked within the coils thereof. Extending the extension spring allows for one or more sutures to be threaded therethrough and, by relaxing the extension spring, provides a clamping action upon the sutures and a tortuous path within the coils. The lock actuating device provides a cutting mechanism. Furthermore, both the suture lock assembly, in combination with a lock actuating device, are suitably small enough to pass through the working channel of various endoscopic and ultrasound devices.

In another embodiment of the invention, a suture lock assembly is provided that forms a hollow body, within which a clamp device is engaged and through which one or more sutures is threaded. Depending upon the slidable position of the clamp device within the body, the suture within the clamp device is engaged to clamp the suture permanently. The suture lock assembly of this embodiment is likewise suitably small enough to pass through the working channel of various endoscopic and ultrasound devices.

The various embodiments of the invention can be employed with various types of suture, including without limitation monofilament suture and braided suture.

**BRIEF DESCRIPTION OF THE DRAWINGS**

While the novel features of the invention are set forth with particularity in the appended claims, the invention, in all its embodiments, may be more fully understood with reference to the following description and accompanying drawings.

**FIG. 1A** illustrates a perspective view of a suture lock assembly in accordance with a first embodiment of the invention;

**FIG. 1B** illustrates a cross-sectional view of the suture lock assembly in accordance with a first embodiment of the invention;

**FIG. 2** illustrates a side view of an exemplary lock actuating device according to the first embodiment;

**FIGS. 3A and 3B** illustrate a side view and a top view, respectively, of the distal end of the lock actuating device with the suture lock assembly of the first embodiment engaged therein in the default state;

**FIGS. 4A and 4B** illustrate a side view and a top view, respectively, of the distal end of the lock actuating device with the suture lock assembly of the first embodiment engaged therein in the lock state;

**FIGS. 5A and 5B** illustrate a side view and a top view, respectively, of the distal end of the lock actuating device with the suture lock assembly of the first embodiment engaged therein in the cut state;

**FIG. 6** illustrates a side view of the suture lock assembly of the first embodiment engaged therein in the release state;

**FIG. 7** illustrates a flow diagram of an example method of using the suture lock assembly of the first embodiment in combination with the lock actuating system;

**FIG. 8** illustrates a perspective view of a suture lock assembly in accordance with a second embodiment of the invention.

**FIG. 9** illustrates a cross-sectional view of the suture lock assembly of the second embodiment in the unlocked state.

**FIG. 10** illustrates a cross-sectional view of the suture lock assembly of the second embodiment in the locked state.

**FIGS. 11A and 11B** illustrate cross section views of an alternative locking device with a one-way flap inside a tubular segment, in a loading state, and a locked state, respectively.

**FIGS. 12A and 12B** show a cross section view of alternative one-piece clip in a default state, and a cross section view of the one-piece clip in a locked state, respectively.

**DETAILED DESCRIPTION OF THE INVENTION**

**FIG. 1A** illustrates a perspective view of a suture lock assembly 100 in accordance with a first embodiment of the invention. Suture lock assembly 100 includes an extension spring 112 arranged between a distal endcap 114 and a proximal endcap 116.

Extension spring 112 is formed of any nontoxic, noncorrosive metal, such as stainless steel, and distal endcap 114 and proximal endcap 116 are formed of, for example, molded plastic or stainless steel. Also shown in FIG. 1 is a suture 118 threaded first through a hole 120 in distal endcap 114 and then through multiple coils of extension spring 112, wherein suture 118 is clamped because of the pressure of the coils and the tortuous path within the coils. Suture lock assembly 100 is not limited to a single suture 118 installed therein; a plurality of sutures 118 may be engaged within a single suture lock assembly 100.

**FIG. 1B** illustrates a cross-sectional view of suture lock assembly 100 taken along line AA of FIG. 1A. This view shows that proximal endcap 116 further includes a hollow channel 121 that runs through its center. Furthermore, hole 120 in distal endcap 114 is angled from the center of an outer end of distal endcap 114 toward the sidewall of distal endcap 114, which thereby allows suture 118 to exit distal endcap 114 external to extension spring 112. Distal endcap 114 and proximal endcap 116 may be insert-molded onto extension spring 112 or use other methods or procedures of providing a smooth, trauma free extension of spring coils.

In operation, suture 118 is threaded first through hole 120 in distal endcap 114; extension spring 112 is then extended and suture 118 is threaded through multiple coils of extension spring 112; extension spring 112 is then relaxed, which thereby applies a tortuous path in addition to a clamping or locking action upon suture 118 between the coils thereof. The overall diameter of suture lock assembly 100 is suitably small enough to allow it to pass through the working channel of various endoscopic and ultrasound devices, which is typically between 2.8 and 3.4 mm in diameter. See Table 1 for example dimensions of suture lock assembly 100.
TABLE 1
Example dimensions of suture lock assembly 100.

<table>
<thead>
<tr>
<th>Example Dimension</th>
<th>Suture lock assembly 100 overall length</th>
<th>Extension spring 112 outside diameter</th>
<th>Extension spring 112 inside diameter</th>
<th>Distal endcap 114 outside diameter</th>
<th>Distal endcap 114 length</th>
<th>Proximal endcap 116 outside diameter</th>
<th>Proximal endcap 116 length</th>
<th>Hollow channel 121 diameter</th>
<th>Hole 120 diameter</th>
<th>Hole 120 angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suture lock assembly 100 overall length</td>
<td>0.70 in</td>
<td>0.060 in</td>
<td>0.040 in</td>
<td>0.07 in</td>
<td>0.15 in</td>
<td>0.07 in</td>
<td>0.125 in</td>
<td>0.04 in</td>
<td>0.04 in</td>
<td>45 degrees</td>
</tr>
</tbody>
</table>

**[0031]** FIG. 2 illustrates a side view of a lock actuating device 200, which is exemplary only and representative of any suitable actuating device for use with suture lock assembly 100. In this example, lock actuating device 200 includes a body 210 that has a knob 212 arranged at its proximal end for grasping by the user. Mechanically coupled to body 210 is a retract handle 214, which has a retract handle body 216 and a retention handle 218 that is slidably arranged within retract handle body 216. Furthermore, a compression spring 220 is mechanically coupled between a spring retainer 222, which is coupled to knob 212, and the proximal end of retract handle body 216. Mechanically coupled to the distal end of retract handle body 216 is a hollow retractable sleeve 224, within which is arranged a hollow retention sleeve 225, which has a retention jaw 226 at its distal end. Furthermore, arranged within retention sleeve 225 is an actuating shaft 228. FIG. 2 also shows that arranged within the distal end of retractable sleeve 224 is a first slot 230 that is aligned opposite a second slot 232. Also, arranged within the distal end of retention sleeve 225 is a hole 234 that is aligned opposite a slot 236.

**[0032]** Actuating shaft 228 of a fixed length is mechanically coupled at one end to the distal end of spring retainer 222 while passing through spring retainer 222. Actuating shaft 228 passes through a hollow channel within retract handle body 216, then passes through the hollow channel of retention jaw 226 within retractable sleeve 224. The tip of actuating shaft 228 extends through an opening at the distal end of retention jaw 226 within retractable sleeve 224. Using retract handle 214 and retention handle 218, retractable sleeve 224 and retention sleeve 225 are slidably along the length of actuating shaft 228. As a result, the relative axial position of retractable sleeve 224, retention jaw 226, and actuating shaft 228 may vary one to another under user control. Lock actuating device 200 may include well-known mechanical methods and elements (not shown) for holding retractable sleeve 224 and retention jaw 226 at various positional states.

**[0033]** The operation of suture lock assembly 100 in combination with lock actuating device 200 for automatically locking and cutting a suture includes a sequential transition from a default state (i.e., undeployed state) to a lock state, a cut state and, finally, a release state (i.e., deployed state), as described in reference to FIGS. 3A, 3B, 4A, 4B, 5A, 5B, 6, and 7. Additionally, FIGS. 3A, 3B, 4A, 4B, 5A, 5B, and 6 show suture lock assembly 100 in use and, therefore, it includes suture 118, which runs through the center of suture lock assembly 100 and approximates a first tissue 122 and a second tissue 124. Suture 118 is anchored to second tissue 124 with a T-tag 126, which is a well-known medical device for anchoring a suture into body tissue.

**[0034]** FIGS. 3A and 3B illustrate a side view and a top view, respectively, of the distal end of lock actuating device 200 with suture lock assembly 100 engaged therein in the default state, which is described as follows.

**[0035]** Default state: In the default or undeployed state, extension spring 112 is extended suitably to allow suture 118 to slide freely through its coils. This is accomplished by the physician’s passing actuating shaft 228 through hollow channel 121 of proximal endcap 116, then through the center of extension spring 112, until the tip of actuating shaft 228 abuts the inner surface of distal endcap 114. By using retention handle 218, which is attached to the proximal end of retention sleeve 225, the physician extends retention jaw 226 to allow it to grip proximal endcap 116 and then pull proximal endcap 116 into the tip of retractable sleeve 224, as shown in FIGS. 3A and 3B, which thereby extends extension spring 112, relative to the tip of actuating shaft 228. The distance between the tip of actuating shaft 228 and the tip of retractable sleeve 224 is predetermined to suitably extend extension spring 112. Additionally, suture 118 is threaded first through hole 120 in distal endcap 114, then within the extended coils of extension spring 112 is wrapped multiple times around actuating shaft 228, through first slot 230 of retractable sleeve 224, through hole 234 of retention sleeve 225, passes around actuating shaft 228, through slot 236 of retention sleeve 225 and, finally, through second slot 232 of retractable sleeve 224.

**[0036]** FIGS. 4A and 4B illustrate a side view and a top view, respectively, of the distal end of lock actuating device 200 with suture lock assembly 100 engaged therein in the lock state, which is described as follows.

**[0037]** Lock state: In the lock state, extension spring 112 is relaxed, which allows its coils to clamp against suture 118 and thereby prevent suture 118 from sliding freely between the coils of extension spring 112. By using retention handle 218, which is attached to the proximal end of retention sleeve 225, the physician extends retention jaw 226 while gripping proximal endcap 116 in a direction toward distal endcap 114 and while maintaining the relative distance between the tip of actuating shaft 228 and the tip of retractable sleeve 224, as set in the default state. Although the relative position of hole 234 and slot 236 to first slot 230 and second slot 232, respectively, is changed, suture 118 is intact and passing freely through first slot 230 of retractable sleeve 224, through hole 234 of retention sleeve 225, passes around actuating shaft 228, through slot 236 of retention sleeve 225, and through second slot 232 of retractable sleeve 224, as shown in FIGS. 4A and 4B.

**[0038]** FIGS. 5A and 5B illustrate a side view and a top view, respectively, of the distal end of lock actuating device 200 with suture lock assembly 100 engaged therein in the cut state, which is described as follows.

**[0039]** Cut state: In the cut state, the relative distance between the tip of actuating shaft 228 and the tip of retention jaw 226 is maintained, as set in the lock state. By using retract handle 214, which is attached to the proximal end of retractable sleeve 224, the physician retracts tip of retractable sleeve 224 in a direction away from the tip of retention.
jaw 226, which causes the position of hole 234 and slot 236 within retention sleeve 225 to change, relative to first slot 230 and second slot 232, respectively, such that suture 118 within hole 234 is cut as hole 234 passes underneath the edge of first slot 230, which has a ground edge suitable for cutting suture 118.

[0040] FIG. 6 illustrates a side view of suture lock assembly 100 in the release state, which is described as follows.

[0041] Release state: In the release state, the physician manipulates the grasp of retention jaw 226 and proximal endcap 116 is released, which allows all instrumentation, such as lock actuating device 200 and the endoscope, as well as the surplus length of suture 118, to be removed. Extension spring 112 remains relaxed and, thus, the locking action upon suture 118 is maintained indefinitely within the patient.

[0042] In an alternative embodiment, rather than wrapping the suture 118 multiple times around shaft 228 within the extended coils of spring 112, the suture 118 can be manually threaded through or otherwise positioned between the extended coils, such as in a serpentine fashion, so that the coils hold the suture when the coils are permitted to close together. Such manual positioning of the suture through the coils may be employed if the shaft 228 is not employed or is otherwise not positioned within the spring 112 when the suture is positioned with respect to the coils of spring 112.

[0043] FIG. 7 illustrates a flow diagram of an example method 700 of using suture lock assembly 100 in combination with lock actuating device 200 in accordance with the invention. More specifically, method 700 provides an example of a posterior gastropexy procedure that uses suture lock assembly 100 of the present invention. The use of suture lock assembly 100 is not limited to a posterior gastropexy procedure; suture lock assembly 100 may be used in any of various, similar medical procedures. Furthermore, method 700 is not limited to a single suture 118 installed within suture lock assembly 100; a plurality of sutures 118 may be engaged within a single suture lock assembly 100.

[0044] At step 710, a physician passes an EUS endoscope through a patient’s mouth and esophagus and into the stomach. Example EUS endoscopes include endoscope model GF-UC160P-AT8 manufactured by Olympus Europe (Hamburg, Germany) and endoscope model EG-3630U manufactured by Pentax Medical Company (Orangeburg, N.Y.). The working channel of the EUS endoscope is preloaded with a standard EUS needle, such as is manufactured by Wilson-Cook (Winston-Salem, N.C.), that serves as a carrier for a tag and suture, such as T-tag 126 and suture 118. Suture 118 may run either through the needle or outside the needle, but still inside the working channel of the EUS endoscope.

[0045] At step 712, under the guidance of the EUS endoscope, the physician locates and identifies structures outside the stomach wall and selects a fixation point, such as the median arcuate ligament.

[0046] At step 714, under the guidance of the EUS endoscope, the physician pushes the EUS needle, which is carrying T-tag 126 and suture 118, through the stomach wall, which is represented by first tissue 122 in FIGS. 3A, 3B, 4A, 4B, 5A, 5B, and 6.

[0047] At step 716, under the guidance of the EUS endoscope, the physician deploys and affixes T-tag 126, with suture 118 attached thereto, to the fixation point, such as to the median arcuate ligament, which is represented by second tissue 124 in FIGS. 3A, 3B, 4A, 4B, 5A, 5B, and 6.

[0048] At step 718, the physician withdraws the EUS endoscope and associated instrumentation from the patient, but leaves a length of suture 118 still threaded through the patient’s gastroesophageal tract and anchored to second tissue 124 (e.g., median arcuate ligament). The length of suture 118 extends out of the patient’s mouth and is accessible to the physician.

[0049] At step 720, the physician threads the length of suture 118 that is extending out of the patient’s mouth into the distal end and out of the proximal end of the working channel of a standard endoscope that has a standard vision system (i.e., not an EUS endoscope).

[0050] At step 722, while holding tension on suture 118, the physician passes the endoscope through the patient’s mouth and esophagus and into the stomach. A length of suture 118 is left extending out of the proximal end of the working channel of the endoscope and is accessible to the physician.

[0051] At step 724, the physician loads suture lock assembly 100 into the distal end of lock actuating device 200 and sets suture lock assembly 100 into the default state, as described in reference to FIGS. 3A and 3B.

[0052] At step 726, with suture lock assembly 100 in the default state and loaded into lock actuating device 200, the physician first threads the length of suture 118 that is extending out of the proximal end of the endoscope through hole 120 in distal endcap 114, then within the extended coils of extension spring 112 is wrapped multiple times around actuating shaft 228, then threaded through hole 234 of retention sleeve 225, then threaded through first slot 230 of retractable sleeve 224, then threaded through second slot 236 of retention sleeve 225 and, finally, threaded through second slot 232 of retractable sleeve 224, as shown in FIGS. 3A and 3B.

[0053] At step 728, while holding tension on suture 118, which is extending out of second slot 232 of retractable sleeve 224, the physician passes the suture lock assembly 100 and retractable sleeve 224 of lock actuating device 200 through the working channel of the endoscope and into the patient’s stomach. Suture lock assembly 100 is sliding freely along suture 118 in the default state, until distal endcap 114 is firmly abutted against the inside of the stomach wall, which is represented by first tissue 122 in FIGS. 3A, 3B, 4A, 4B, 5A, 5B, and 6.

[0054] At step 730, having determined that the desired geometry change between the stomach and the median arcuate ligament (represented by first tissue 122 and second tissue 124) is achieved and while continuing to hold tension on suture 118, the physician whiles suture lock assembly 100 into the lock state by using retention handle 218, as described in reference to FIGS. 4A and 4B, which causes the coils of extension spring 112 to relax and create a tortuous path and, thus, clamp against suture 118, as shown in FIGS. 4A and 4B.

[0055] At step 732, having secured suture lock assembly 100 against first tissue 122 with suture 118, the physician
sets suture lock assembly 100 into the cut state by using retract handle 214, as described in reference to Figures 5A and 5B, which causes suture 118 to be cut as hole 234 passes underneath the edge of first slot 230, which has a geometry suitable for cutting suture 118, as shown in FIGS. 5A and 5B.

[0056] At step 734, having secured suture lock assembly 100 against first tissue 122 and having cut suture 118, the physician releases retention jaw 226 from proximal endcap 116 of suture lock assembly 100, which allows all instrumentation, such as lock actuating device 200 and the endoscope, and the surplus length of suture 118, to be withdrawn from the patient, while suture 118 remains firmly clamped, as shown in FIG. 6. Method 700 ends.

[0057] FIG. 8 illustrates a perspective view of a suture lock assembly 800 in accordance with a second embodiment of the invention. Suture lock assembly 800 includes a cylindrical-shaped lock body 810 that further includes a plurality of suture channels 812 that run therethrough, and which have an associated plurality of locking holes 814 arranged on the outer surface of lock body 810. Suture lock assembly 800 further includes a lock sleeve 816 that further includes a cavity 818 (shown in FIGS. 9 and 10) within which lock body 810 is inserted. Lock body 810 further includes a first groove 824 and a second groove 826, which are detents formed around the outer perimeter of lock body 810. Lock sleeve 816 further includes a first locking ring 820 and a second locking ring 822, which are raised regions protruding from the inside perimeter of cavity 818 that are sized to lock within the detents formed by first groove 824 and second groove 826 of lock body 810.

[0058] Also shown in FIG. 8 is suture 118, which is anchored to second tissue 124 with T-tag 126 passes through first tissue 122 and into one of the suture channels 812, and exits lock body 810 via one of associated locking holes 814. Only a small portion of the distal end of lock body 810 is then inserted into cavity 818, such that locking holes 814 are not within cavity 818 of lock sleeve 816. Lock body 810 and lock sleeve 816 are formed of, for example, molded plastic or stainless steel.

[0059] FIG. 9 illustrates a cross-sectional view of a suture lock assembly 800 and shows suture 118 passing through one of the suture channels 812 and existing lock body 810. FIGS. 8 and 9 are representative of suture lock assembly 800 in the default, unlocked state wherein one or more sutures 118 may be threaded freely through lock body 810. In the default or unlocked state first locking ring 820 of lock sleeve 816 is engaged within second groove 826 of lock body 810, as shown in FIGS. 8 and 9.

[0060] FIG. 10 illustrates a cross-sectional view of a suture lock assembly 800 in a locked state wherein all or more sutures 118 is threaded through lock body 810 and locked therein. More specifically, in the lock state, lock sleeve 816 is pushed over the entire length of lock body 810, such that suture 118 is clamped between the outer surface of lock body 810 and the wall of cavity 818 of lock sleeve 816, after which any surplus suture 118 material is cut, which leaves suture lock assembly 800 secured against first tissue 122. In order to achieve the locked state enough force is applied to lock sleeve 816 against lock body 810 such that first locking ring 820 of lock sleeve 816 disengages from within second groove 826 of lock body 810. In doing so, lock sleeve 816 slides upon lock body 810 until first locking ring 820 and second locking ring 822 are engaged within first groove 824 and second groove 826, respectively, of lock body 810, as shown in FIG. 10. The mechanical features of suture lock assembly 800 for coupling lock sleeve 816 to lock body 810 are exemplary only and are not limited to first locking ring 820, second locking ring 822, first groove 824, and second groove 826. Any well-known coupling method that allows a default and lock state by sliding lock sleeve 816 upon lock body 810 may be used.

[0061] The overall diameter of suture lock assembly 800 is suitably small enough to allow it to pass through the working channel of various endoscopes and ultrasound devices, which is typically between 2.8 and 3.4 mm in diameter. See Table 2 for example dimensions of suture lock assembly 800.

**TABLE 2**

<table>
<thead>
<tr>
<th>Example Dimension</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lock body 810 length</td>
<td>0.35 in</td>
</tr>
<tr>
<td>Lock body 810 outside diameter</td>
<td>0.07 in</td>
</tr>
<tr>
<td>Suture channel 812 diameter</td>
<td>0.015 in</td>
</tr>
<tr>
<td>Lock sleeve 816 length</td>
<td>0.38 in</td>
</tr>
<tr>
<td>Lock sleeve 816 inside diameter</td>
<td>0.07 in</td>
</tr>
<tr>
<td>Suture lock assembly 800 overall length</td>
<td>0.39 in</td>
</tr>
</tbody>
</table>

[0062] The method of using suture lock assembly 800, in combination with suture 118, T-tag 126, first tissue 122, and second tissue 124, is generally the same as described in FIG. 7, in reference to suture lock assembly 100, in that it is fed down the working channel of an endoscope and into, for example, a patient's stomach, in much the same manner. However, suture lock assembly 800 requires no special actuating device; instead, it may be pushed through the working channel of an endoscope with, for example, the tip of a standard catheter. Additionally, its use differs from suture lock assembly 100, in that suture lock assembly 800 requires separate instrumentation for cutting the one or more sutures 118 engaged therein.

[0063] FIGS. 11A and 11B illustrate an alternative locking device similar in function to those previously mentioned. The locking device of FIGS. 11A and 11B are designed to lock onto suture 118, when used in conjunction with the endoscope. The locking device of FIGS. 11A and 11B may be placed on suture 118 attached to T-tag 126, that has been placed through first tissue 122 and second tissue 124 using the previously-described technique.

[0064] This embodiment comprises a tubular sleeve 1100, a flap 1105, and a dent 1120. Tubular sleeve 1100 may have an outer diameter of about 2.6 mm and an inner diameter of about 1 mm, and may be injection molded from a suitable polymer, such as polycarbonate, as a single piece or as separate pieces which are then fused together to form a unitary structure. In a resting state, flap 1105 is biased toward contact with dent 1120. Therefore, to load suture 118 into tubular segment 1100, an introducer 1130 may be used to create space between flap 1105 and dent 1120 as shown in FIG. 11A. Introducer 1130 may be placed into tubular segment 1100 by pulling from a distal end 1122 of
tubular segment 1100, so that flap is moved away from detent 1120. Suture may be placed through a central lumen 1135 of introducer 1130, so that ultimately suture 118 is positioned within tubular segment 1100. Introducer 1130 is then removed by pulling it out of tubular segment 1100 from a proximal end 1133, so that introducer 1130 is not trapped between tubular segment 1100 and second tissue 124.

[0065] After introducer 1130 is removed, tubular segment 110 may be pushed along suture 118 toward second tissue 124 with a pusher 1140 especially designed for that purpose, as shown in FIG. 11B. Tension on suture 118 acts to pull flap 1105 partially away from detent 1120 during advancement. When distal end 1122 of tubular segment 1100 reaches second tissue 124, pusher 1140 is withdrawn and flap 1105 traps suture 118 against detent 1120 so that tubular segment 1100 is held securely in place.

[0066] FIGS. 12A and 12B show another alternative concept for locking onto suture 118. FIG. 12A shows a perspective view of a clip 1200 comprising a first gripping surface 1210, a second gripping surface 1220, an opening 1230, and a clasp 1240. In a default state, clip 1200 is open as shown in FIG. 12A, so that suture 118 can pass freely through opening 1230. Clip 1200 may be placed on suture 118 attached to t-tag 126, that has been placed through first tissue 122 and second tissue 124 using the previously-described technique. Clip 1200 may be placed onto suture 118 so that clasp 1250 is directed toward second tissue 124 and opening 1230 is directed toward the user. Clip 1200 may be pushed down suture 118 using a long flexible tube, such as an endoscope.

[0067] To lock clip 1200 onto suture 118, a horn 1270 including a tapered surface 1272 may be used to apply force at a proximal end of clip 1200, so that first gripping surface 1210 mates with second gripping surface 1220 to securely hold onto suture 118, while clasp 1280 holds clip 1200 closed. Clip 1200 may be made from any suitable polymer material, such as nylon. Clip 1200 may be injection molded as a unitary piece with a “living hinge” that biases the part to an open position in which a first gripping surface 1210 is held away from second gripping surface 1220 in a default open state or assembled from multiple pieces.

[0068] While the present invention has been illustrated by description of various embodiments, it is not the intention of the applicants to restrict or limit the spirit and scope of the appended claims to such detail. Numerous other variations, changes, and substitutions will occur to those skilled in the art without departing from the scope of the invention. Moreover, the structure of each element associated with the present invention can be alternatively described as a means for providing the function performed by the element. It will be understood that the foregoing description is provided by way of example, and that other modifications may occur to those skilled in the art without departing from the scope and spirit of the appended Claims.

1. A medical device for locking onto suture comprising:
   a first endcap, wherein said first endcap includes a hole bored at an oblique angle to a central axis;
   a second endcap; and
   an extension spring extending from said first endcap to said second endcap.

2. The medical device of claim 1 wherein first endcap and said second endcap have an outer diameter of no more than about 0.07 inch.

3. The medical device of claim 1 wherein said hole has a diameter of about 0.04 inch, and is bored at an angle of about 45 degrees to the central axis.

4. A medical device for locking onto suture comprising:
   an endcap; and
   an extension spring associated with said endcap, wherein said spring coils are biased in a compressed state; and
   a length of suture held by said spring.

5. The medical device of claim 4 wherein said endcap has an outer diameter of no more than about 0.07 inch.

6. The medical device of claim 4 wherein the suture is monofilament.

7. The medical device of claim 4 wherein the suture is braided.

8. A medical device comprising:
   a first endcap, wherein said endcap includes a hole bored at an oblique angle to the central axis of said endcap;
   a second endcap;
   a spring disposed intermediate the first and second endcaps; and
   a suture extending through said hole in said first endcap.

9. A method of holding suture comprising the steps of:
   providing a first member having a suture receiving hole;
   providing a second member associated with the first member, the second member comprising a plurality of coils;
   providing a length of suture;
   threading a suture through said hole in said first member;
   spreading the coils of said second member; and
   holding the suture with coils of the second member.

10. The method of claim 7 further comprising the step of:
   spreading the coils apart to loosen tension in said suture.

11. A medical device for locking onto suture comprising:
   a body portion, wherein said body portion includes at least one suture channel;
   a lock sleeve positioned over an outer surface of said body portion;
   wherein said lock sleeve has an inner surface that closely matches the outer surface of said body portion; and
   a means for locking said body portion within said lock sleeve.

12. The medical device of claim 11, wherein said locking means comprises a groove in said body portion and a ring projection in said locking sleeve.

13. The medical device of claim 11, wherein there is a clearance of about 0.001 inch or less between the outer surface of said body portion and the inner surface of said locking sleeve.

14. A method of using a medical device to lock onto suture comprising the steps:
   providing a device comprising a body portion, wherein said body portion includes at least one suture channel;
a lock sleeve positioned over an outer surface of said body portion, wherein said lock sleeve has an inner surface that closely matches the outer surface of said body portion; and a means for locking said body portion within said lock sleeve;

threading a suture through said suture channel;
pushing said locking sleeve over said body portion to trap said suture in a tortuous path; and
locking said locking sleeve to said body portion.

15. A medical device for locking onto suture comprising:
a tubular sleeve including an inner channel;
a flap disposed within said inner channel of said tubular sleeve; and

a detent, wherein said detent is positioned within said inner channel such that said flap is biased to press against said detent.

16. A medical device for locking onto suture comprising:

A first gripping surface including a plurality of projections;
a second gripping surface, wherein said second grip surface is not in contact with said first grip surface in a default state; and

a clasp, wherein said clasp holds said first gripping surface against said second gripping surface in a locked state.